RELATION OF SAUGER CATCH TO TURBIDITY IN LAKE ERIE

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Studies of meteorological and limnological conditions reveal that factors other than intensity of fishing may relate to the abundance of certain fishes in Lake Erie. Present investigations point to the importance of turbidity of water as a determinant of future availability of the sauger, *Stizostedion canadense* (Smith), to commercial operations in Ohio.

This research has been conducted at the Franz Theodore Stone Laboratory of The Ohio State University, under the direction of Dr. T. H. Langlois and members of the staff, and has received full help and co-operation from the Ohio Division of Conservation and Natural Resources. Monthly averages of the turbidity of Lake Erie, 3 miles off Cleveland, have been furnished through the kindness of Mr. Clyde Irwin, chemist at the Baldwin Filtration Plant in Cleveland.

The sauger constitutes about 7% of the total Ohio Commercial catch in Lake Erie. About 67% of these saugers are taken in trap nets, and 82% of the 1939 poundage was taken in the spring season in that portion of Ohio waters west of Fairport. These considerations have prompted inquiry into the relation between the sauger catch, the number of trap nets, and turbidity conditions in the spring.

At first, knowing that the greater part of the sauger catch was made with trap nets, the number of nets licensed and the total commercial poundage of saugers were compared from 1927 through 1939. (Table I). The correlation is quite insignificant. Also, variation in the sauger catch is greater than in the number of nets, indicating the possible influence of some factor other than intensity of fishing upon the abundance of fish.

April and May are the months in which saugers spawn and the fry hatch, in western Lake Erie. Supposing that there was a relation between the muddiness of the water and the success of spawning and survival of the young, evidence of this success should be apparent in the commercial catches after such time as the fish have attained the minimum legal length of 11 inches, which is when they are 3 years of age (2). In most seasons,

3-year-old fish are dominant in commercial catches. (Table II). Following such a course of reasoning, a statistically significant (1, 3, 4,) positive coefficient of correlation of 0.79 was found

TABLE I

THE SAUGER CATCH IS THE TOTAL COMMERCIAL POUNDAGE TAKEN IN THE OHIO WATERS OF LAKE ERIE. THE NUMBER OF NETS REPRESENTS THE SUM OF BOTH SPRING AND FALL TRAP NET LICENSES. TURBIDITIES ARE THE MEAN APRIL-MAY AVERAGES AT CLEVELAND. PRECIPITATION IS THE MEAN RAINFALL FOR APRIL-MAY AT TOLEDO, SANDUSKY AND CLEVELAND.

Year	Saugers, Lbs., Uncorrected for Number of Nets A	Saugers, Corrected, Lbs., 0000 Omitted B	Number of Nets C	Turbidity, p. p. m. D	Precipitation, Inches E
1927	1,144,197	124	6,939	22	5.7
1928	1,491,867	143	7,853	25	4.1
1929	1,528,887	156	7,356	44	9.9
1930	1,482,396	164	6,780	20	4.5
1931	1,726,528	181	7,166	9	5.4
1932	3,094,284	317	7,342	10	4.8
1933	2,124,111	218	7,333	23	7.1
1934	737,708	81	6,876	6	4.6
1935	1,479,410	147	7,543	(24) 6	4.2
1936	1,703,999	159	8,064	9	3.8
1937	1,172,194	102	8,648	18	6.9
1938	802,075	75	8,069	13	6.3
1939	1,661,269	160	7,793	.....	.....

Between D and A 3 yrs. later: $r = +0.79$ $z = 1.06$ $\sigma z = \pm 0.38$
$bAD = 49.8$ $aA = 732$

Between D and B 3 yrs. later (1927–'36) $r = +0.82$ $z = 1.15$ $\sigma z = \pm 0.38$

rCA = —.002 (Not signif.) rDE (1927–'38) = + 0.60

TABLE II

NUMBERS AND AGES OF FISH IN SAMPLES OF OHIO COMMERCIAL SAUGERS, LAKE ERIE. MINIMUM LEGAL LENGTH, 11 INCHES.

Year	2 an	3 an	4 an	5 an
1937.....	0	12	10	0
1938.....	1	10	26	5
1939.....	0	140	82	2

between the mean April-May turbidities and Ohio sauger catches 3 years later, from 1927 to 1936. (Fig. 1). Correction of the catch figures, to allow for the various numbers of nets fished in different years, gives a correlation coefficient of +0.82, between

April-May turbidities and sauger catches 3 years later. These coefficients do not differ statistically.

There are various influences upon the turbidity of a lake. Nature of the shores, depth, the direction of the long axis of the lake in relation to the magnitude and direction of winds, and precipitation may all affect the turbidity of the water. Several rivers enter western Lake Erie along the south shore. These rivers flow through the rich soil of highly cultivated farmlands, and after every rain carry a heavy load of suspended matter into the lake. A statistically significant r of +0.60 was found between the mean April-May precipitation at Toledo, San-

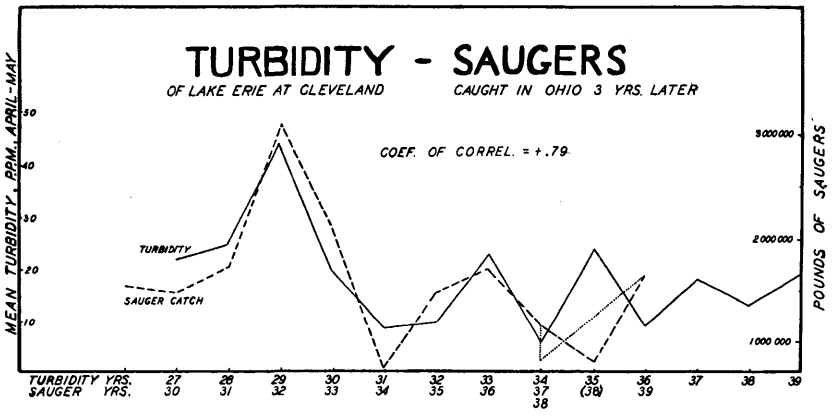

FIG. 1 Graph illustrating the relationship between mean April-May turbidities of Lake Erie off Cleveland and the Ohio commercial catch of saugers three years later. The 1938 catch, as well as that of 1937, were largely of the same dominant year class of 1934 (see Table II), and both relate to the turbidity of 1934 as indicated by the dotted line.

dusky and Cleveland (5) and the mean April-May turbidity at Cleveland, from 1927 to 1938. Perhaps the precipitation did not affect the turbidity of the lake through turbid river inflow, as suggested, but that rainy weather was accompanied by high winds which stirred up the sediments in the shallower parts of the lake. In any event, by no matter how many degrees of relationship removed, a connection between precipitation and turbidity is apparent.

Three possible explanations to account for good sauger catches in Ohio 3 years after high spring turbidity may be suggested:

(1) The young saugers may, in clouded water, receive

protection from predators feeding chiefly by sight. A higher survival in turbid water would result.

(2) Limnological work at present being conducted by Dr. D. C. Chandler at the Stone Laboratory indicates that during periods of low light penetration, including high turbidity, microcrustacea are closer to the top than when the water is clear and more freely penetrable by light. Sauger fry feed near the surface when they are small, and so would have available a greater concentration of food under turbid conditions than when the water is clearer, with the plankton scattered down about 5 meters. Better feeding should promote a higher survival.

(3) Hatchery practice sometimes involves the use of powders, chalk or humus, to coat eggs which would otherwise adhere in clumps, the latter resulting in the smothering and death of the inner eggs. It may be that eggs freed by fish spawning in turbid waters rapidly gather a coating which makes them less able to adhere to one another. Eggs falling to the bottom singly might be expected to have a better chance of hatching than those in aggregations.

CONCLUSIONS

Of the factors, other than intensity of fishing, relating to the abundance of certain fishes in western Lake Erie, turbidity of the water is important. A highly significant degree of correlation ($r = +0.79$) has existed for the past 10 years between the mean April-May turbidities as measured at Cleveland and the total Ohio sauger catch 3 years later. There is considerable evidence that the lake turbidities during these months bear a significant relationship ($r = +0.60$) to the mean precipitation in the same months at several points along the southwestern shore of the lake. It is suggested that higher turbidities may act to prevent stickiness in sauger eggs, may give young fry protection from predators, and may facilitate the young saugers' feeding by concentrating plankton organisms near the surface.

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